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CROP ROTATION IMPACT ON THE MAIZE CROP PESTS

Alexandru RANTEȘ

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, 011464, Bucharest, Romania

Corresponding author email: alex_rantes@yahoo.com

Abstract

Due to its high yielding capacity and its adaptability, the maize crop has become the main crop grown by Romanian farmers. Although the most important problem in maize cultivation were weed control, in recent years the pest control has become as important as the weed control. Due to the long monoculture, farmers are faced with very high pest densities, which leads to a reduction in yield but also in its quality, in extreme cases completely compromising the crop, making it necessary to reseed the crop. Pests of the maize crop target its entire vegetation period, and therefore farmers are subject to higher production costs by applying additional insecticide treatments. The objective of the present paper is to present the influence of crop rotation on the density and the attack intensity of the main pest of the maize crop. The research was performed under field conditions in South Romania (Giurgiu county, Putineiu location) in 2022, and the pests taken into account were Tanymecus dilaticollis Gyll. (maize leaf weevil), Helicoverpa armigera Hb. (cotton bollworm or corn earworm) and Ostrinia nubilalis Hbn. (corn borer).

***Key words**: maize, Tanymecus dilaticollis, Helicoverpa armigera, Ostrinia nubilalis, crop rotation.*

INTRODUCTION

Maize crop is the main crop grown by Romanian farmers. As a C4 plant, maize has a high capacity to produce biomass (Dicu et al., 2016), and it has the highest grain yield potential among the cereal crops (Ion et al., 2015b).

Crop rotation is used by farmers for centuries with the purpose of preventing crop diseases and pests, as well as nutrient imbalances in the soil, all these to make production more efficient and to obtain qualitative yields.

The crop rotation is the practice of alternating the annual crops grown in a specific field in a planned pattern or sequence so that the crops of a same species or family are not grown repeatedly without interruption on the same field. Crop rotation is a critical feature of all organic cropping systems because it provides the principal mechanism for building healthy soils, a major way to control pests, and a variety of other benefits. Crop rotation means changing the type of crop grown on a particular piece of land from year to year (Charles Mohler, 2009).

Crop rotation used to be the driving means of controlling pests and weeds for thousands of years, before the green revolution, however today various management practices exist for this purpose. (European Commission DG ENV, 2010).

Growing the same crop on the same agricultural area for many consecutive years is known as monoculture and it gradually depletes the soil of certain nutrients and greatly favors the multiplication of specific diseases, pests and weeds (Roman, 2011).

The preceding crop is an important crop technology measure with a significant influence upon the yield (Ion et al., 2015a).

Crop rotation should be based on some criteria, such as vegetation period of cultivated plants, their water and nutrients requirements, as well as their specific diseases and pests, or the plant capacity to leave nutrients in the soil, such as leguminous plants etc.

The benefits of crop rotation for land and water resource protection and productivity have been identified, but many of the rotation factors, processes and mechanisms responsible for increased yield and other benefits need to be better understood (Berzsenyi et al., 2000).

The effect of crop rotation on maize yield is inversely proportional to the ratio of the maize in the crop rotation (Šeremešić et al., 2013). This effect has represented and continues to do so, the object of many research performed

under different soil and climatic conditions (Ștefan et al., 2018).
Pests are most easily kept in balance when different crops are grown over a number of years. Rotate susceptible crops at intervals to inhibit the buildup of their specific pest organisms. Rotation length should be based on the amount of time soil-borne pathogens remain viable in the field (Tennessee Department of Agriculture).
Maize leaf weevil (*Tanymecus dilaticollis* Gyll.) is considered to be a regional pest in the European Union, been located mainly in the south-east countries (Meislle et al., 2010). In Romania, this is one of the most dangerous pests of the maize crops, about one million hectares cultivated with maize being attacked each year by this pest with different levels of attack intensities (Georgescu et al., 2011).
The corn earworm (*Helicoverpa armigera* Hb.) is a cosmopolitan, widespread species (Pălăgesiu and Crista, 2010), but this is beginning to become a growing problem for European maize producers and implicitly for those from Romania (Grozea et al., 2019).
Ostrinia nubilalis Hbn. is spread throughout Romania, the frequency of attack is, on average, between 30.3% and 70%, larvae causing attacks and production losses by feeding with different parts of the maize plant (stem, cobs, inflorescence) (Pintilie et al., 2022).
The objective of the present paper is to present the influence of crop rotation on the density and the attack intensity of the main pest of the maize crop.

MATERIALS AND METHODS

The research was conducted in experimental plots located in Southern area of Romania, in the Burnaz Plain, in Giurgiu county, Putineiu location (43°52'59'' North Latitude, 25°40'1'' East Longitude, 67 m altitude), in the year 2022.
The climate of the year 2022 was favorable for maize growing. At the time of sowing, the soil had both moisture and temperature sufficient for a good germination of the seeds (Figures 1 and 2).

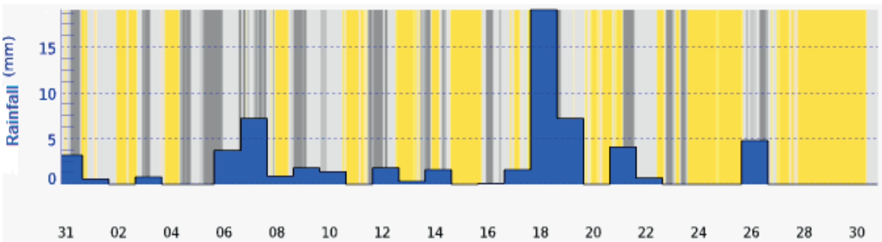

Figure 1. The amount of rainfall in April 2022 (source: https://www.meteoblue.com/)

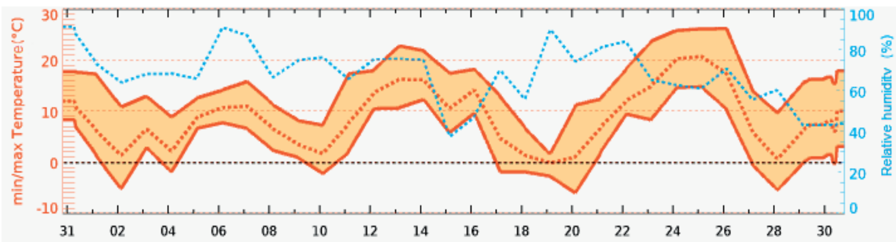

Figure 2. Temperatures recorded in April 2022 (source: https://www.meteoblue.com/)

The experimental plots were sown on April 10th. The cultivation technology was a classic one for maize cultivation, with deep plowing in the fall, followed in the spring by fertilizing the land, incorporating fertilizers into the soil with a cultivator and then sowing.
The preceding crops were the following: winter wheat; peas; soybean; rapeseed; maize monoculture in year 1; maize monoculture in year 2; maize monoculture in year 3.
The seeds were treated with Nuprid AL 600 FS (imidacloprid 600 g/l) with the rate of 8 l/t.

In the experimental plots, the pest density and the intensity of the pest attack on the maize crop were monitored depending on the preceding plant. The main pests that constituted the subject of this experiment were: *Tanymecus dilaticollis* Gyll. (maize leaf weevil), *Helicoverpa armigera* (Hübner) (cotton bollworm or corn earworm) and *Ostrinia nubilalis* (Hübner) (corn borer).
The attack intensity of *T. dilaticollis* was measured with the help of Paulian's scale.
According to this grading scale, the intensity of the attack ranges from 1 (plant not attacked) to 9 (completely destroyed plant).
Pheromonal traps were used to measure the pest density of *H. armigera* and *O. nubilalis*.
The intensity of the attack by *H. armigera* and *O. nubilalis* was determined by consecutively counting on 100 maize plants and observing how many of them were attacked, thus resulting in the attack percentage.

RESULTS AND DISCUSSIONS

The pest density in the experimental plots for *Tanymecus dilaticollis* registered the highest values in the case of maize monoculture, especially when the monoculture was performed for 2 and 3 years (Figure 3). This is according to the findings of Georgescu et al. (2011) who identified in south-east of Romania that maize monoculture has an increasing effect on pest density associate with a higher impact on the attack. It is interesting to highlight that the pest density in the case of wheat as preceding crop for maize was comparable with those obtain when the maize followed maize as preceding crop for one year. The smallest values were registered when maize followed peas and rapeseed.
The pest density in the experimental plots for *Helicoverpa armigera* registered the highest values in the case of maize monoculture, especially when the monoculture was performed for 2 and 3 years (Figure 4). In the case of this pest, it is interesting to highlight that the density in the case of soybean as preceding crop for maize was quite high, even higher than values registered when the maize followed maize for one year. The smallest values were registered when maize followed, wheat, peas and rapeseed.

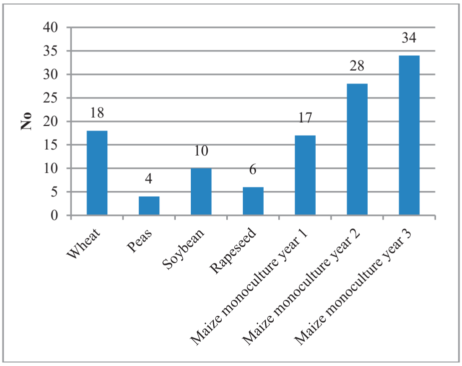

Figure 3. Pest density (number/m^2) for *T. dilaticollis*

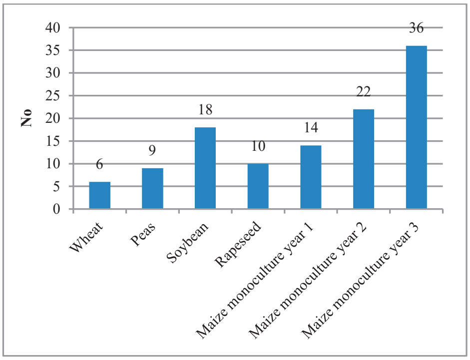

Figure 4. Pest density (number/trap) for *H. armigera*

As in the case of the preceding pests, the pest density in the experimental plots for *Ostrinia nubilalis* registered the highest values in the case of maize monoculture, especially when the monoculture was performed for 3 years (Figure 5). When the maize followed other crops (peas, soybean, wheat and rapeseed) than maize, the registered values were small.

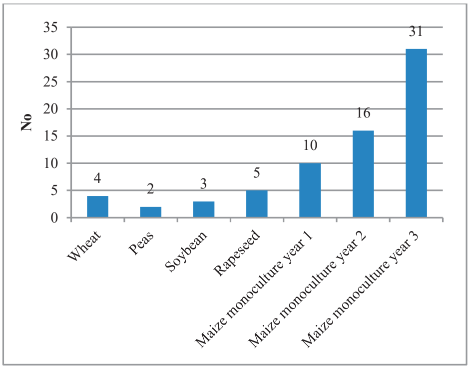

Figure 5. Pest density (number/trap) for *O. nubilalis*

The attack intensity of the *T. dilaticollis* registered the highest grade in the 3-year maize monoculture (Figure 6). The lowest grade was recorded for the peas as preceding crop.

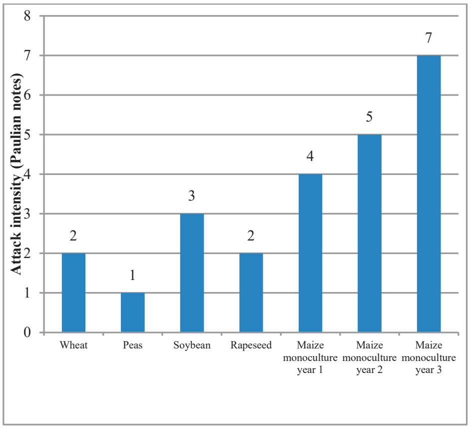

Figure 6. Attack intensity for *T. dilaticollis*

The attack intensity of the *H. armigera* registered the highest percentage of plant attacked in the 3-year maize monoculture (Figure 7). The lowest percentage was recorded for the wheat as preceding crop. Being a polyphagous pest, we can also observe a strong intensity of the attack after the soybean crop, where *H. armigera* started to raise big problems, the value being very close to the maize monoculture year 1.

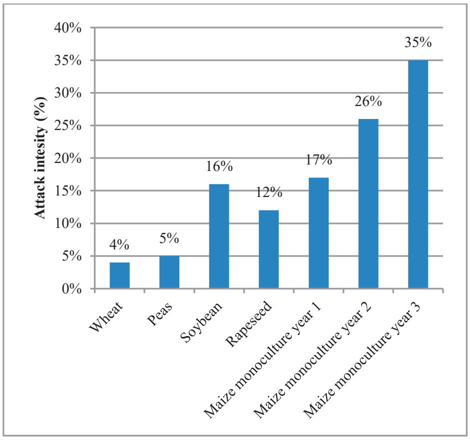

Figure 7. Intensity attack for *H. armigera*

The attack intensity of the *O. nubilalis* registered the highest percentage of plant attacked in the 3-year maize monoculture (Figure 8). The lowest percentage was recorded for the wheat and peas as preceding crops. Although the lowest percentages were recorded for wheat and peas with only 2% of plants attacked, soybean and rapeseed can be considered very good precursor crops as well because the values are very close to the minimum ones.

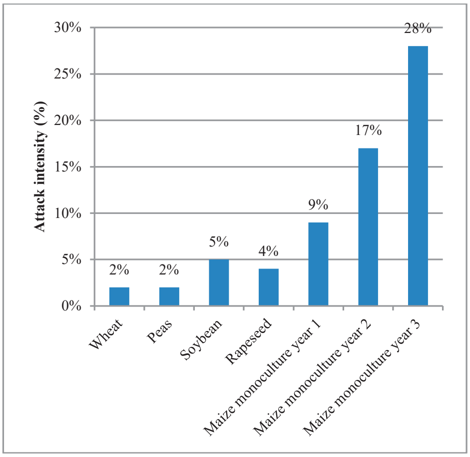

Figure 8. Intensity attack for *O. nubilalis*

CONCLUSIONS

Maize monoculture increase the density and attack intensity of the studied pest, respectively *Tanymecus dilaticollis* Gyll. (maize leaf weevil), *Helicoverpa armigera* (Hübner) (cotton bollworm or corn earworm) and *Ostrinia nubilalis* (Hübner) (corn borer). The values of density and attack intensity are higher the longer the maize monoculture lasts.

The density and attack intensity of *Tanymecus dilaticollis* Gyll. were smallest when the maize followed peas as preceding crop.

The density and attack intensity of *Helicoverpa armigera* (Hübner) were smallest when the maize followed wheat and peas as preceding crops.

The density and attack intensity of *Ostrinia nubilalis* (Hübner) were smallest when the maize followed wheat, peas, soybean and rapeseed as preceding crops.

The crop rotation represents one of the best methods of controlling pest densities and attack intensity in maize crop.

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